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ABSTRACT

Chaos theory provides a powerful lens for re-seeing a number of issues in composition studies ranging in scale from achieving a generative model for text production to articulating the very nature of the discipline. Chaos systems are nonlinear, have complex forms, manifest recursive symmetries between scale levels, have feedback mechanisms, and are extremely sensitive to initial conditions. Writing over computer networks is a chaotic system. The production of most texts, not only those collaboratively written, is a chaotic process. The development of individual writing abilities cannot be modeled by linear equations. The complexity of how texts constitute a discipline is well described by chaos ideas. Composition studies exhibit a fractal structure, as do chaos studies. The experience of entering the field of composition studies, trying to grasp its various elements, parallels the transition to turbulence. The consolation of chaos theory is that within the field regions of stability do exist, if only expectations of what constitutes order are shifted. (Fifteen references are attached.) (RS)

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Strange Attractors: Chaos Theory and Composition Studies

Whenever I teach an introduction to composition studies, I see reflected in the class the same dismay I felt as a fledgling graduate student. Then, I aspired to a sort of unified field theory that would sort out the discipline. That I couldn't bring one into focus was a sign of my own inadequacy. I sense the same feeling in many students, and I'll confess not having lost it entirely myself. But I think our frustration will diminish if we shiftour expectations of how composition studies are unified.

James Gleick's book on Chaos popularized a branch of science that had developed since the 1960's. Chaos theory is a paradoxial enterprise. Its goal is to articulate order within disorder, to show that systems as diverse as the weather and cream clouds in coffee cups are not random. But neither are they explicable through the models of classical physics. Chaos theory has been applied to everything from lynx populations to the effect of Star Wars deployment. I risk being merely trendy, then, by importing chaos into composition studies. Nonetheless, chaos theory provides a powerful lens for re-seeing a number of issues ranging in scale from achieving a generative model for text production to articulating the very nature of the discipline.

I confess that my knowledge of chaos theory is that of someone who earns Quality Paperback Book Club bonus points by purchasing books like Stephen Hawking's A Brief History of Time.. My sources are mostly popular: Gleick's book and, especially N. Katherine Hayle's Chaos Bound. I begin in the popular tradition, then, of talking about the weather.

What will be the temperature and sky conditions in Seattle at noon on January 1, 2001? Several things prevent a reliable prediction. Some may be formal. Meteorologists don't have the sophisticated equations to model the available data . Or perhaps sufficient equations exist, but they belong to a vast class of equations that cannot be solved. Systems that can't be solved analytically can be solved computationally--if sufficently powerful computers exist. But beyond these limits is yet another, even more profound.

Gleick offers the following thought experiment. Suppose that we spread a grid of poles one foot apart across the entire surface of the earth, each pole as tall as the atmosphere, and on each pole, at intervals of one foot we put a cluster a sensors. Imagine, further, that each sensor is connected to a super computer equipped with the best program. Even in this situation, Gleick observes, the weather a month later could not be specified with precision. The problem is all the space between, the missed readings.

The classical response would be that "surely the data is sufficiently precise. "The general state of things is clear from the sampling points." And yet this crosses two tenets of chaos theory. First, the system is infinitely complex. Each finer unit of measurement or analysis reveals more dimensions and irregularity. Second, and more importantly, this complexity matters. This is because the equations describing the system are nonlinear. In nonlinear systems magnitudes of cause and effect do not necessarily correspond. While such equations may sound exotic, they are in fact the rule. Stanislaw Ulam noted that calling chaos "nonlinear science" was like calling zoology "the study of nonelephant animals."

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But let's go a step further. Suppose that, in addition to perfect equations and powers of calculation we had perfect data on every level "down" to the quantum. Following Newton, Pierre LaPlace contended that if we had such information about the universe at any single moment in time, we could know both its past and future. However, chaos theory throws a wrench. Classical physics described the universe as reversible. Information from the past is inscribed in the present in a determinate and extractable way. This means that predicting the weather using perfect data from today would yield the same results as perfect data from five centuries ago.

But chaos theory demonstrates that it would not. The equations involved are extraordinarily sensitive to the initial conditions of the system. Two different initial values, even arbitrarily close together, will not necessarily yield results that are close together. But knowledge of initial conditions cannot be gained from the present system. Origins are unknowable. Thus chaos theory dismisses the problem of origins in much the same way as does Derrida.

We are triply blocked from predicting the weather at noon on January 1, 2001: by formal, analytic, and computational complexities; by the absence of perfect data, and by our inability to know initial conditions. Now, by way of an imperfect analogy, substitute "text" or "discourse" for "weather" or "student writing ability" for weather, and you may see some shadows of my argument. I cannot predict what will be published in the issue of Rhetoric Review current on January 1, 2001, nor can I predict what my seven year old son might write on that day.

Quickly, then, here are some tenets of chaos theory

1. Chaotic systems are nonlinear. As a result they cannot be solved analytically. Magnitudes of cause and effect are not preserved.
2. Chaotic systems have complex forms. Each finer unit of analysis reveals more dimensions and irrregularities, so that measurements do not converge to a limit but increase with each finer scale.
3. Chaotic systems manifest "recursive symmetries between scale levels." A turbulent river, for example, has eddies within eddies within eddies, and so on.
4. Complex systems have feedback mechanisms, by which "output feeds back into the system as input"
5. Chaotic systems are extremely sensitve to initial conditions. Slight differences in initial values can be magnified, though recursive self-similarities within the system, to produce macroscopic effects.

There are two main branches of chaos theory. The "order out of chaos" branch focues on the "spontaneous emergece of self organization," in other words, the ability of a system to generate order out of itself. The "order within chaos" branch demonstrates that some chaotic systems contain deeply encoded structures called 'strange attractors.' I'll say more about them in a few minutes.

But this is probably too much chaos already. Let me, then, explain some implications of chaos theory for composition studies. These topics are arranged cumulatively and in ascending order of conceptual difficulty.

1. Chaos and Writing Over Computer Networks

Consider a text that emerges as writers compose over synchronous (real-time) computer networks. Such a text is shaped by multiple points of view, pieces of information, and experiences, all figured in the individuals linked through hardware. Take a topic like abortion. If we turn a network of writers loose on the topic, we can imagine that certain arguments will come up and will engender certain responses. The discourse on abortion brims with

commonplaces and stock rejoinders. But we cannot predict specific features of the collaborative text, certainly not to the level of sentences or words.

Suppose there are ten writers on the network. Suppose that we know their politics. Suppose we know every aspect of their personalities. Suppose we "know" their customary writing styles. Suppose we know every piece of discourse they have ever heard or read. Imagine, in short, that we realize the Laplacian ideal of knowing for an instant the complete atmospheric conditions in this rhetorical universe. Given all of that, perhaps we could even predict what the 20th sentence of the text would be. But we cannot.

Critical theory might assert that dominant ideologies so leaven small differences that we could predict the important textual features. This treats the writing network in the same way a meteorologist might treat weather data, rounding off measurements in the assumption that the main characteristics of the system will be nonetheless preserved. But small changes are magnified in chaotic systems over time. Alternative phrasings of "similar" messages from one writer may elicit different responses from another. Each addition to the discourse modifies it as feedback.

Unless we know all the initial conditions we cannot predict, except broadly, on the magnitude of a thirty-day forecast, the future of the discourse. The system is chaotic, which is not to say random or orderless or failed. In this chaos lies the possiblity for change.

2. Chaos and the Production of Single-Author Texts

There is a stronger version of my first point. That is, the production of most texts, not only those collaboratively written, is a chaotic process. Except in certain formulaic tasks, writing is not algorithmic. To use a corrupting metaphor, each author comprises his or her own vastly complex network of experience and discourse. This point is familiar, I think, from social constructivist theory, but chaos theory goes even further because it accounts for both order and change. As I noted earlier, one branch of chaos theory stipulates that chaotic systems are self-generative of order. The complexity of the system itself generates the possiblity of change.

In a famous article growing from his attempt to develop predictive models of the weather, Edward Lorenz showed how a system of three nonlinear equations results in a deterministic model of infinite complexity. A compositional equivalent of Lorenz's equations might be Flower and Hayes's model of the writing process, which offers cognitive operations instead of equations. This model strikes me as relatively complete, and yet completeness gains suprisingly little. The model cannot work as linear equation precisely because the Task Environment and Long Term Memory cannot be perfectly specified. Consider Memory, for example, more specifically, "topical knowledge."

If we wished to account for the production of a certain text, how much topical knowledge would we need? When is information topical? How is the way I writer about fishing affected by my remembering that my father rarely went to church on Sunday mrning? (He was fishing instead.) If this model were linear, then there would be some point at which data could be excluded because the general behavior of the model could accurately be estimated. But there is no extraneous information in a chaotic system. The slightest perturbations are magnified throughout it. The process is doubly interative. Each change in the text also modifies the writer's longterm memory and both reenter the system as inputs. Chaos theory, by the way, renders the puzzling monitor unnecessary. Instead of something exterior to the processes somehow managing them, in an executive fashion, the interacting processes are self-organizing and changing.

For most tasks, then, we cannot provide students procedures whose execution will guarantee a desirable text. Of course, there are some tasks bounded by such procedures,

described by formulae like the five-paragraph theme that yield contextually-acceptable writing. Formulaic procedures are like linear equations: fine and useful for handling some important tasks. But the bulk of writing situations are not neatly "solved" by formulae. The reason is not a merely romantic one of how we'd like to imagine the individual writer. Rather, it is in the nature of the process.

In modeling a system's progression to chaos, theorists note that certain input values are more highly charged than others. They create chaos more quickly, which also means they create more possible "orders," however transitory. Good writers create and tolerate complexity. They have multiple experiences and tremendous stores of discourse, with endless combinatorial possibilities. The paradox that writing teachers face, though, is how to inculcate productive complexity when oppositional student, institutional, or social needs for control demand short-term competence.

3. Chaos and the Critique of Stage Models of Development

For a time in composition studies, stage models of cognitive development promised a framework that had both explanatory and pedagogical powers. Dualistic students, for example, could not generate certain types of arguments or adapt their writing to an other. The pedagogical solution was to design and sequence writing assignments so as to accelerate cognitive maturation.

The critiques of stage models are by now familiar. Joseph Williams has characterized learning to write not as a linear, once-and-for-all progression but a discontinous one in which a writer may be competent with some tasks on some topics but incompetent with others. In a graph of time versus writing ability there will not be a single point of "ability" at any given moment but rather a number of them. My ability to explicate a short story guarantee my ability to critique an article from Nature. Rather than describing writing ability with clean single line graphs, even ones whose slopes regularly change, we should consider something a good deal fuzzier. The development of individual writing abilities cannot be modeled by linear equations. But neither is it romantic formlessness.

We can extend this to explain why not all students of a given age or, even a given educational background will perform similar tasks with the same degree of success. There is a strong classical tendency to posit some "normal" level of writing ability and to regard students below it as "not being where they should be." This discounts the inevitable diversity among students by assuming that small difference in experience or background can be nullified by instruction. Surprisingly, some radical theorists display the same tendency when they narrowly focus on the overdetermination of language.

4. Strange Attractors, Discourse Communities, and History

Few concepts have risen and fallen as quickly in composition studies as that of "discourse community." Beyond fuzziness about the term's very meaning are concerns that "discourse community" can be used repressively to exclude writers or thwart change. At the core of the issue is a theoretical dilemma: How is a discourse community--or any system--simultaneously closed and open?

Finally we get to strange attractors. An attractor is a region within a dynamical system to which that system is drawn. It can be represented with phase space diagrams, which show how systems change over time. The simplest attractor is a fixed point attractor. Think of the vertical position of a swinging pendulem. A second attractor is a limit cycle. In this case, the system tends toward a periodic motion of some frequency. Think of metronomes and heart rates. A third type of attractor is a chaotic or strange attractor. These are aperiodic. Here, the phase space respresentation of a sytem neither converges to a point nor

traces a path. But it is not random. Rather, it reveals a pattern of orbits, all different from one another, wandering in complex and unpredicatable ways but yet circumscribed by a certain value.

One approach to explaining how texts constitute a discipline is to posit some common denominator among them, as if they had a fixed point attractor. However, Wittgenstein's concept of family resemblances--individual entities chained to other entities rather all overlapping--explains the relationship among "similar" texts more satisfactorily. Instead of regarding a discipline as constituted by shared conventions centered on a core episteme or point, we might see them as drawn to a strange attractor. Instead of shared features, order is constituted as a way of relating. If it were possible to represent a discipline in phase space, with each text a moment in the system, perhaps the result is something akin to the Lorenz attractor. The discipline is bounded but not predicatable, and it need never repeat itself.

Things are much more complicated than this, of course, for the "system" of a discipline is not neatly circumbscribed but rather exists among other systems. Likewise, individuals working in a discipline are not purely or only in that discipline. But this complexity is well-described by the chaos ideas of scaling phenomena.

5. The Fractal Structure of Composition Studies.

Now I return to the problem with which I began, that of developing some unfied field theory of composition studies. My solution is implicit in my discussions above. Just as we cannot write the metaphoric equations to account for the production of texts and just as discourse communities in general are not organized around fixed points, so we cannot analytically unify composition studies.

And yet the discipline is no more random than the weather. There is a branch of chaos theory that deals with fractal geometry. Consider successive magnifications of a Mandelbrot set. Each successive "blow up," if you will, of the image reveals structural features more or less similar to the preceding image. The progression of self-similarity goes on to infinity. Chaos studies is fractal in nature. The issues of its sub-fields are self-similar, analyzable as scaling phenomena. In other words, the perspectives--the ways of asking questions--that we bring to any one subfield of composition are largely those that we bring to any other subfield.

Consider four questions.

1. How do writers produce a text?
2. How do writers develop as writers?
3. How do discursive formations emerge?
4. How should theory and practice relate?

The analysis of each question "contains" similar problems. For example, each raises questions of the relationship between parts and wholes. What role do particular passages in a text play in the production of the whole text? What role do certain writing experiences play in the formation of a writer? What role do particular texts play in the development of a discursive formation? Each question has a component exploring the relationship between wholes and other wholes; none of these questions can be specifically neatly solved--or answered independently of the others. Let me point out just one consequence of this observation, namely, the way it recuperates the significance of the individual writer. While the system in which the writer works determines what and how she will write, the act of writing also determines the system, which is never stable. For the "writer" we can substitute "the teacher."

A chaos perspective on theory/common sense/practice

All of this has implications for our panel and the relationship between common sense and theory in the teaching of writing. Both common sense and theory reduce the complexity of writing and teaching by representing them in some fewer terms, in the way that physicists try to model dynamic systems. If the system is linear, no problem. But if it is not, this analytical approach which by definition must exclude some information, the models can never have universal predictive powers. I caution against interpreting this absence of a Perfect Pedagogy or Writing Process as a fatalistic justification for taking the path of least intellectual effort. The danger for teachers lies in the static application of common sense or the static application of theory. My argument is not an aesthetic change for change's sake, nor do I imagine a grand slope of Progress for composition studies. Chaos theory promises counteless orders within chaotic systems, countless ways of encompassing a situation. Some are more productive than others. The danger of smug static knowledge (either of theory or common sense) is that it may never generate the chaos that meets a given state of affairs.

Conclusions

Several things make me nervous about my remarks today. Speaking in metaphors opens new ways of thinking, but it risks making plain nonsense harder to detect. Just what does it mean to say that discourse communities are strange attractors or that composition studies is fractal? Are these metaphors really necessary? Couldn't I have discussed the same ideas by staying "within" the discipline? For example, the way I've characterized writing and the field of composition studies is very like the hermeneutic position currently in ascendancy. Perhaps I should have traded Louise Phelps's Composition as a Human Science for Gleick's Chaos. And maybe my motives are merely opportunistic. Knowing how science is valorized in our culture, I tie composition studies to its coattails. Or maybe the arrow of motive points the other way, as I try to argue that science has just begun colonizing modes of interpretation and explanation that composition studies has long inhabited. Much remains to be explored in the articulation of chaos theory and composition studies.

I think the efforts will be rewarding. A classical problem to which chaos theory has been applied is turbulence. Of particular interest has been phase transitions, the region of change between smooth flow and entropy, as in a river entering a rapids. The experience of entering the field of composition studies, trying to grasp its various elements, parallels the transition to turbulence. Most of us come with the same hopes. We pursue a set of principles that, once understood, will guarantee a pedagogy and the conceptual mastery of the field. And yet, soon, all is turbulent. Attention at one level raises problems at another. More reading or teaching only displaces what we thought were solid precepts. The consolation of chaos is that within the field are regions of stability, if only we shift our expectations of what constitutes order.

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Five Tenets of Chaos Theory

1. Chaotic systems are nonlinear.
2. Chaotic systems have infinitely complex forms.
3. Chaotic systems manifest recursive symmetries between scale levels.
4. Chaotic systems have feedback mechanisms.
5. Chaotic systems are sensitive to initial conditions.

Chaos Theory and Composition Studies

1. Synchronous computer networks are chaotic systems.
2. (Strong version of #1) Writing is a chaotic process.
3. Chaos theory can be used to critique stage models of writing development.
4. Discourse communities might best be understood as strange attractors.
5. The order of composition studies is fractal in nature.
6. Chaos theory recasts the theory/common sense/practice issue.